

Mammography: a history of success and scientific enthusiasm

Mamografia: uma história de sucesso e de entusiasmo científico

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The assessment of breast by imaging methods has been object of a series of recent publications in the Brazilian radiological literature⁽¹⁻¹¹⁾. In the present editorial, we report the international contribution, the beginnings of the mammographic study, and a fascinating evolution of diagnostic medicine.

THE AGE OF PIONEERS

In 1913, Albert Salomon, a German surgeon, published his monograph about the utility of radiological studies of mastectomy specimens, demonstrating the possibility of correlating radiological, macro and microscopic anatomy of breast diseases with differentiation between benign and malignant entities⁽¹²⁾.

Major works followed that of A. Salomon, namely, Kleinschmidt, Warren, Vogel, Seabold, Gerson-Cohen, Leborgne, Egan, Gallagher, Martin, Dodd, Strax, and colleagues. The intriguing study developed by the renowned pathologist Helen Ingleby, in 1950, included the assessment of the breast and its variations according to the patients' age and menstrual status, besides a radiological, micro and macroscopic correlation with a technique of cross-sectional histological sections of the breast^(13,14). In 1949, Raul Leborgne revitalized the interest in mammography calling the attention over the need for technical qualification for patients positioning and over radiological parameters to be adopted. He was a pioneer in the enhancement of imaging quality, besides putting special emphasis on the differential diagnosis between benign and malignant calcifications⁽¹⁵⁾.

Special films developed by Kodak, and the high miliamperage with low kilovoltage technique standardized by Robert Egan have led to a new level of technical qualification. In 1962, this author reports the first 53 cases of occult breast cancer detected at 2,000 mammograms.

At that same time, John Martin and colleagues demonstrated that excellent mammographic studies could be performed and standardized in private clinics. Concomitantly, the American College of Radiology (ACR) established committees and centers for training at countrywide level. This was the embryo for the ACR Mammography Committee⁽¹²⁻¹⁴⁾.

THE AGE OF TECHNICAL PROGRESS

The so called *Age of Technical Progress* has Gould, Wolfe, Gross and their collaborators amongst its major contributors. The

development of xeromammography was the result from collaboration between industry and medicine. In 1960, Howard and Gould described imaging improvements obtained with the xeromammography technique and, in 1966, in the 5th Conference on Mammography at Emory University (Atlanta), John Wolfe presented his vast experience in the use of xeromammography.

The interest was so high that ACR asked Xerox to institute an advanced research program with the method, including new clinical essays, with the contribution from Wolfe, Martin and Gloria Frankl. It is important to highlight that at that time Wolfe already classified the subtle signs of breast cancer and their relationship with the breast parenchyma density⁽¹⁶⁾.

In 1965, Charles Gross, from Strasbourg, France, developed the first unit dedicated to mammography. Ingeniously, such an apparatus presented a molybdenum x-ray tube with a 0.7 mm focal spot, providing high differential contrast between parenchyma, fat and microcalcifications; complemented by an appropriate compression system as a relevant addition to the equipment. Gross has worked with great dedication, constantly calling the attention to the great potential of mammography to detect occult cancers⁽¹²⁾.

THE MODERN AGE

The *Modern Age*, as this period became known, counts on the contribution of Price, Butler, Ostrum, Becker, Isard, Moskowitz, Sickles, Kopans, Homer, Tabár and collaborators, among others.

In 1970, Price and Butler, utilizing high definition intensifying screens and mammography films, obtain great success in the reduction of radiation levels. In this respect, the companies Kodak and Dupont are responsible for a great technical contribution.

In 1974, Myron Moskowitz and collaborators presented preliminary results about mammographic screening and call the attention of the medical community to the capacity of mammography to diagnose minimally invasive cancer.

In 1977, Sickles, Kunio Doi and Genant published their results about mammography magnification, emphasizing the permanent necessity of adding new devices to mammography apparatuses, given the relevance of new developments in this field. Sickles insists on the need for technical capacitation and constant improvements, and emphasizes the necessity of diagnosing malignant tumors with basis not only on the classical signs, but also on indirect and less noticeable signs. Already at that time, the concept of mobile mammography units was popularized⁽¹⁷⁾.

In 1976, Frank, Ferris and Steer described a preoperative needle/wire system for marking nonpalpable breast lesions and,

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in 1980, Kopans and DeLuca exemplify the improved system of this method. Currently, the utilized needles are named Kopans wires⁽¹⁸⁾.

In 1985, László Tabár and collaborators described results obtained with mammographic screening in 134,867 women in the age range between 40 and 79 years, with a single mediolateral oblique image, reporting a mortality decrease of 31%.

Tabár has developed tireless scientific work, with innumerable publications, conferences and courses. Such author also promotes several courses in the areas of epidemiology, screening, early diagnosis and establishes new concepts about clinical-radiological-pathological correlation, with a systematic analysis of sections of specimens and mammographic findings⁽¹⁹⁾. In addition to this author, innumerable other radiologists have devoted their extensive experience to teach and divulge mammography. In this field, the studies developed by Eklund, Feig, Logan, Alcon, and Paulus should be highlighted.

DIGITAL MAMMOGRAPHY

In September/1991, under the auspices of US National Institute of Health, and in accordance with breast diagnosis specialists consensus about breast diagnosis, it was established a priority of investments for development of digital mammography.

At that time, developments in digital technology were already being observed in all radiology fields, mammography inclusive.

In June/1996, the Food and Drug Administration (FDA) publishes normative guidelines as regards clinical essays for interested companies to obtain official approval to commercialize digital mammography equipment. The Food and Drug Administration estimates that a comparative study of at least 520 women (260 with abnormal findings and 260 with normal findings) would be enough to meet the pre-established evaluation parameters. Further studies are developed and a detailed analysis of the new system confirms the technical excellence of the method, particularly in the acquisition, equalization, display and post-processing of images⁽¹⁴⁾.

The first digital equipment

From 2000 on the Senographe 2000 D equipment was approved by FDA. The equipment for direct digital mammographic image acquisition is composed of an x-ray generator similar to that of the conventional system. The great innovation consists in the introduction of a computerized control unit (with automated quality control) and the replacement of the screen/film system by a

highly differentiated electronic detector that is effective in x-ray beam absorption.

Currently, several companies are involved in the development and commercialization of digital mammography apparatuses, computer-aided diagnosis (CAD) systems and breast tomosynthesis, the latter approved in 2011 by FDA.

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